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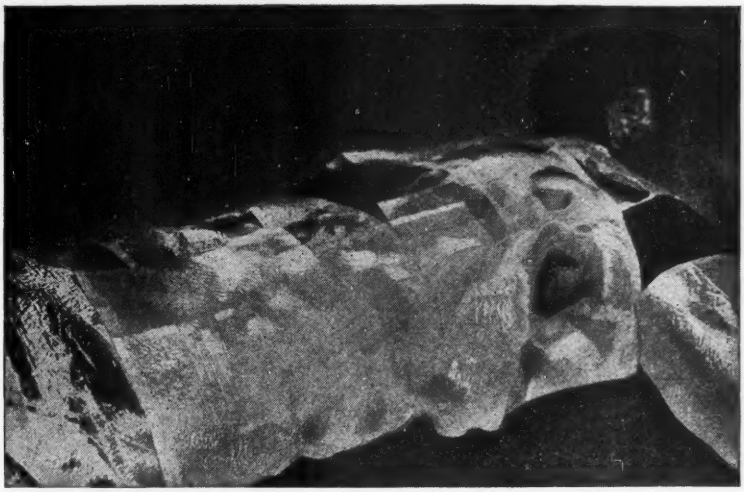

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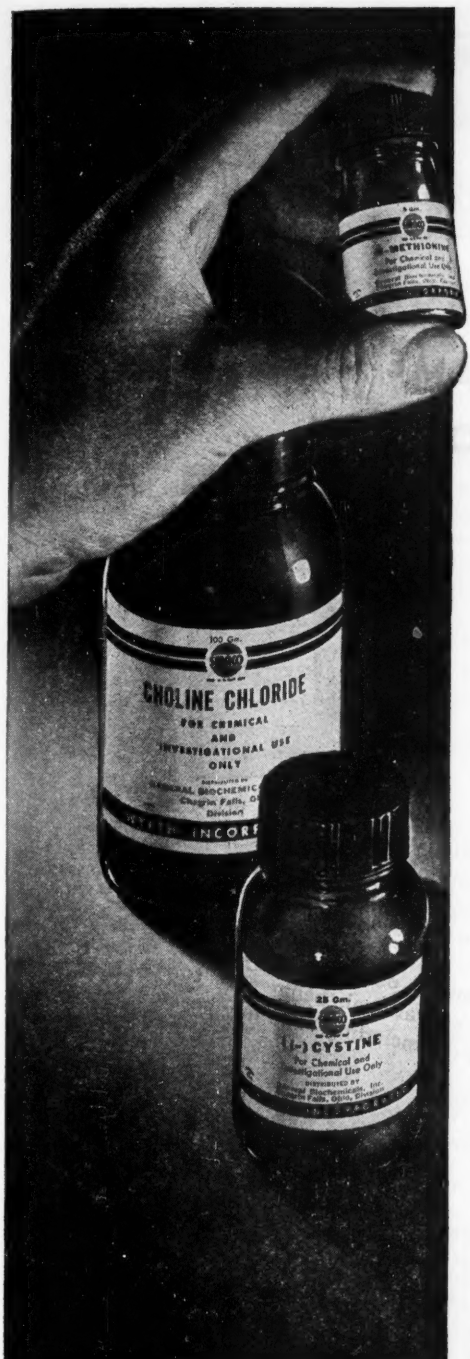
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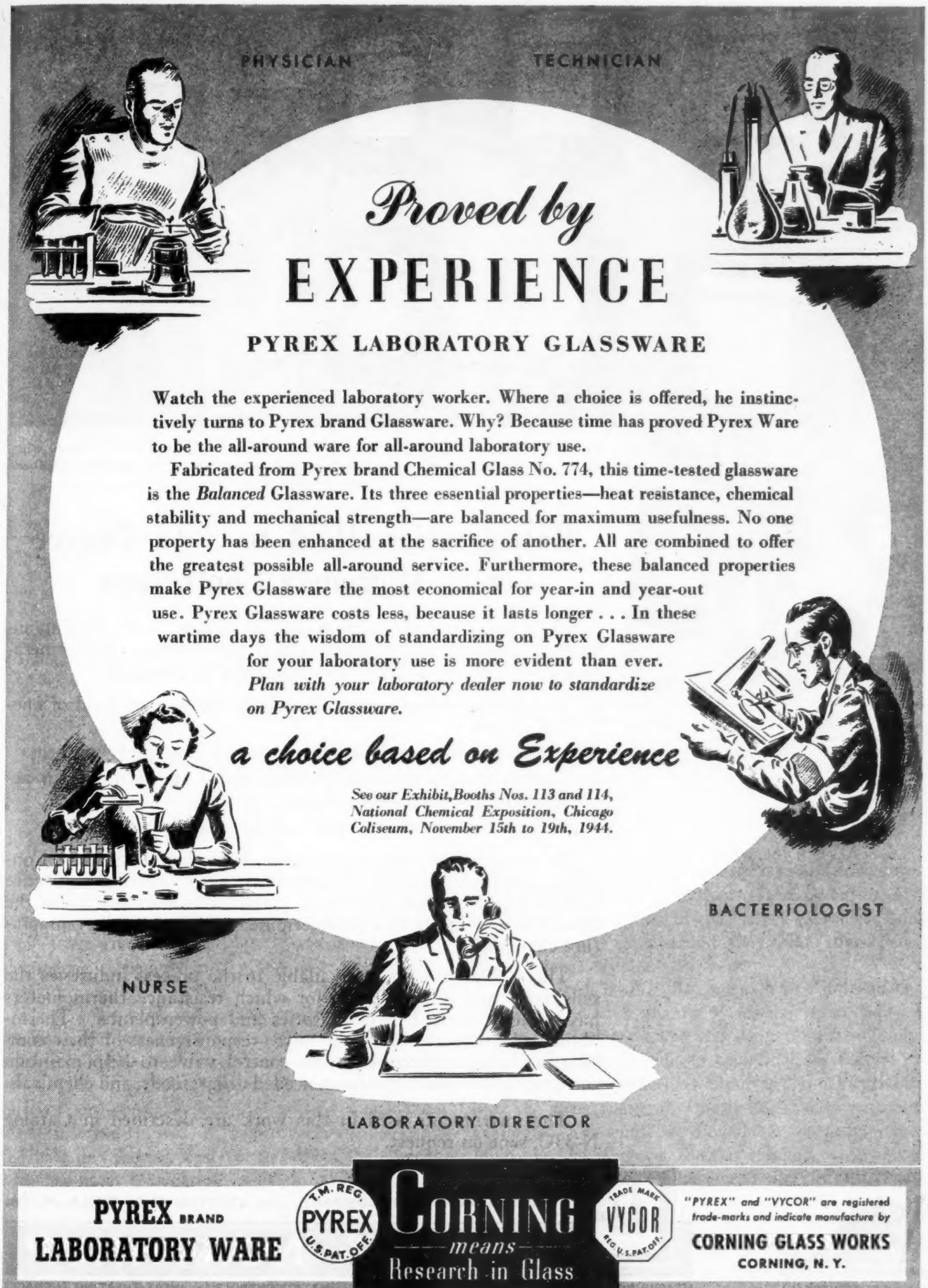
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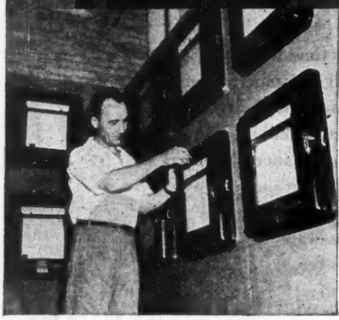

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THE HISTORY OF SCIENCE IN POSTWAR EDUCATION[1]

By Professor HENRY E. SIGERIST

THE JOHNS HOPKINS UNIVERSITY

THERE can be no doubt that the history of science as a subject of instruction has been greatly neglected in the past and is still very much neglected to-day. Few of our great universities offer any courses at all, and among them only a very few offer adequate instruction.

There was a time, not so long ago, when studies in the history of science were considered an unnecessary luxury, a hobby for retired scientists. Science was progressing rapidly, was becoming increasingly complicated and specialized, and everybody was looking ahead into the future. It seemed useless to look into the past and seemed wasteful to burden the students with historical considerations.

The attitude toward the history of science is changing rapidly, for reasons that we shall discuss in a moment. Leading scientists, historians and educators, presidents of great universities have come out openly in favor of instruction in the history of science and have repeatedly emphasized the great educational value of such studies.

They talked, beautifully, but as a rule did not act. When you have a chance to discuss these matters with such an educator and you ask him quite candidly why he does not provide, in his school, instruction in a field that he considers so important, you invariably hear the same answers. One is that funds were not available. Yet funds were available for many other purposes, and wherever there is a sound constructive program and the determination to carry it out, funds usually come forth.

Another and more serious answer is that the school intended to provide instruction in the history of science but could not find the right man to teach the subject. And in such a case the educator will usually

[1] Address of the retiring vice-president of Section L, American Association for the Advancement of Science, presented at the meeting in Cleveland on September 12, 1944.

add: "Why do you not train the people that we so urgently need?"

To this very justified and challenging question we reply that it is difficult to encourage young people to enter into a field in which so far there have been no outlets. A man has to make a living, and after many years of highly specialized training in the history of science, he usually ends up teaching elementary biology or chemistry or Latin in a college, and his training remains unused. If universities had chairs for the history of science, then, of course, we would be only too eager to train people for these positions. The problem, in other words, reverts to the old proposition whether the egg or the hen comes first.

There is, however, another and much more disturbing aspect to the question, namely, that it is becoming increasingly difficult, particularly in this country, to find young people who possess the elementary equipment required for studies in the history of science. We expect as a matter of course that a historian of philosophy have a profound understanding of philosophy but be at the same time fully trained in methods of historical research. A historian of music must understand music but must be a historian as well. The same requirement obviously applies to the historian of science. He must understand science. We do not expect him to be equally competent in astronomy, botany and chemistry, but he must know at least one field of science thoroughly. And he must be a historian in addition, that is, he must be able to read and evaluate and interpret historical sources.

In view of the fact that ancient science dominated the Western world for over two thousand years and that Latin remained the language of science for several centuries thereafter, it is pretty obvious that the historian of science who wants to work from first-hand sources, who wants to teach the subject and to guide student research must know Greek and Latin, and must know these languages well. It is not enough for him to be able to decipher a Latin text; he must be able to read it. Of course, it would be good for him to know also Arabic and half a dozen other languages, but a thorough knowledge of Greek and Latin is a minimum requirement for a man who wants to become an academic teacher in the history of science.

We all know that it is very difficult to-day to find young people who are equally well trained in the humanities and in science. It was different in the past when the humanities were the gateway to university studies. This is why in the nineteenth century great scientists and physicians, men like Berthelot, Du Bois-Reymond, Virchow and many others were able to make important contributions to the history of science. When they became interested in the history of their field, they had a background from which they could draw. To-day the scientist who becomes interested in history encounters almost insurmountable barriers. He is unable to read the basic texts, has to rely on translations and on secondary sources. In my own field, the history of medicine, a number of disgraceful books have been published recently that would have been inconceivable one or two generations ago. They were written by very competent doctors who, however, had not had the slightest humanistic training, had no appreciation of the historian's responsibility and were totally unable to distinguish between good and bad sources.

Young people who come to us for training have usually had a few years of high-school Latin and no Greek at all. Their knowledge of general history is extremely scanty. They can, of course, learn Greek and Latin and general history at the university, and we urge them to do it. But the result is that the time that should be spent for specialized training actually has to be spent in acquiring the most elementary tools. Our Johns Hopkins Institute of the History of Medicine offers the degrees of M.A. and Ph.D. in medical history, but in twelve years we have given only one M.A. degree and no Ph.D. We had candidates, but most of them gave up after a while realizing that their preparation was hopelessly inadequate.

And yet, in spite of these undeniable difficulties, we are fortunate in having in the United States to-day a number of scholars who are fully prepared to fill chairs of the history of science. George Sarton, the foremost authority in the field, has been active in this country for more than a quarter of a century and has developed a flourishing school. Scattered all over the country, in various positions, are young people, scientists, philosophers, philologists and historians who in spite of sometimes considerable difficulties have become very competent in some field of the history of science. What they need is a few years of leisure without academic duties that they could spend with Sarton at Harvard or in some similar center. This would give them an opportunity to accomplish a solid piece of research and to broaden their training whereupon, I am sure, many of them would be prepared to teach the history of science competently.

An interesting and promising experiment in this direction was undertaken recently by the Johns Hopkins University. In 1940, the university with the aid of the Carnegie Corporation created two Carnegie Fellowships in the History of Graeco-Roman Science. They were each for two years and carried an annual stipend of $2,000 with the usual privileges granted to research fellows. The idea was to steer young classical philologists into the field of ancient science where so much remains to be done, so that later while teaching the classics they would devote their re-

searches to the history of science and would also be able to teach the subject.

When the fellowships were announced, we received over 20 applications. The two candidates accepted were both doctors of philosophy in classics, and in addition one of them was an excellent mathematician and physicist who had already published a number of papers, while the other had engaged in studies of botany. The two fellows were attached to the Institute of the History of Medicine. They attended all courses of the department and took an active part in the seminars. As a matter of fact, the research seminar was turned over to them repeatedly for a number of weeks, so that they had an opportunity to present their problems in detail and to have them discussed. One was working on Theophrastus, the other on Caelius Aurelianus and on several other problems. Both were also permitted to teach in a postgraduate course that the department gave in 1942.

The war somewhat interfered with the program, in that one fellow interrupted his work after one year to take a position with the Navy. The other, however, completed his two years very successfully. He is a solid researcher and excellent teacher who, in my opinion, would be an asset to the faculty of any university. I very much hope that these fellowships will be resumed after the war and possibly even extended, because they seem to be a step in the right direction. It is obvious that not every college can have a department of the history of science, but every one has a department of classics, and to have one man in such a department who combines classics with science and is prepared to teach the history of science should prove to be a great advantage.

At any rate, competent teaching personnel is available to-day, not in large but in sufficient number to make a start, and it is therefore up to the schools to take the next step by creating teaching positions. Once they are available, without any doubt more personnel will be trained.

A great deal of planning is being done to-day, and this is a very sound symptom. It shows that we are trying to learn from the experience of the war. We feel that much was wrong, in many fields, in the prewar world, and we endeavor to improve conditions by planning intelligently for the post-war world which, we feel, must and will be different.

The war has revealed dramatically the inadequacy of our educational system. Not only has it shown that with 341,200 registrants rejected for military service (up to September 1, 1943) for being unable "to read and write the English language as well as a student who has completed four years in an American grammar school," we have an amount of illiteracy for which there is no excuse in a democracy, but the mere fact that we did nothing to prevent this war is an indictment of our educational system. We marched merrily through the boom years into the depression, watched the rise of fascism and nazism without moving a finger, let the Spanish Republic be crushed and supplied Japan with the raw materials she needed to fight China—and us—until we ourselves were drawn into the maelstrom. We can not blame the politicians, because their actions are determined by public opinion, and public opinion is the result of the educational status of the population.

Whenever we have an opportunity to probe into the present situation, we find appalling conditions. A poll conducted in July, 1943, revealed that in spite of all means of information, newspapers, radio, movies, 79 per cent. of the population had never heard that at that time there was a hotly contested National Social Insurance Act before Congress, a bill which, if passed, would take 6 per cent. of all wages and give the people great social security benefits. The poll showed that 84 per cent. of the farm population had never heard of the bill, one which for the first time included the farm laborers. This reveals a lack of education in citizenship that is simply staggering. How can we expect a democracy to function effectively if the majority of the citizens take no interest in some of the most vital issues that concern their own security? And what is to blame but our educational system? Education in citizenship, however, presupposes an intelligent teaching of history.

A survey conducted by *The New York Times* several years ago revealed that thousands of young people graduate from colleges every year with a bachelor's degree without having had any instruction in the history of their own country. How can we expect them to become enlightened citizens prepared to take an active part in determining the destinies of the nation?

It seems that many people still consider the study of history some kind of a luxury. Oh, they will gladly admit that it is interesting to know what happened in the past, and how people lived in the early days. They will concede that an educated person should have some knowledge of history, but after all we are living in to-day's world with its hard realities, in ever changing situations and, they usually add, nobody has ever learned from history.

At this very moment important inter-allied conferences are being held at which plans are elaborated for reshaping the world. They are attended by statesmen and diplomatists with staffs of experts in economics, geography and other fields, but it is striking to see that historians are hardly ever consulted. Historians are considered as college professors who

know all about the past but, of course, have no idea of the world in which they live.[2]

Nothing could be more erroneous than such an attitude. History is not a luxury. The knowledge and views we have of our past are the most powerful driving forces in our life. Every situation in which we find ourselves, every event that takes place, whether it be a world war, a revolution, a strike or merely the enactment of a city ordinance, are all the results of certain developments and trends. We are usually not aware of them and are therefore often surprised when the event takes place. The historical analysis that makes these developments and trends conscious, that reveals the factors that have led to a given situation, permits us to understand what is happening around us and helps us to act more intelligently.

The study of history must be given a prominent place in postwar education if we are determined to train not only specialists but citizens of a democracy. This has been recognized in various quarters, and efforts are being made to give history more hours in the curriculum. Criticism of existing conditions, however, has been more along quantitative than qualitative lines. Much has been said about the number of courses and hours the students should have, yet it is obvious that a great deal depends on what kind of historical instruction is being offered. And this is where the history of science comes in.

Science has played such a tremendous part in shaping our world and is bound to play an increasingly important part in the world of to-morrow that it is impossible to understand historical developments without considering science. It is strange, therefore, that there are still many text-books of history in which the word science hardly occurs.

The time is fortunately gone when the teaching of history centered around dynastic quarrels, boundary disputes and wars. We are primarily interested in the history of man's achievements and creations, in the history of that broad complex of phenomena commonly called civilization. Man's efforts to understand and master nature certainly represent one very important aspect of it. We do not neglect to study the many factors that have advanced or retarded the development of civilization. Dynastic quarrels, boundary disputes and wars may have been such factors and therefore will not be overlooked. The basic importance of economic factors is generally recognized, and history has in many hands become primarily economic history. Economic history, however, must always consider the history of man's tools, of his technology, and technology is to a large extent the result of science.

Science has not only revolutionized our economic life but has also profoundly influenced our views of life, our religion, philosophy, literature and art. It is impossible to understand the naturalist school without knowing Claude Bernard, the physiologist. The influence of Darwin is still widely felt. In other words, from whatever angle we approach history we are bound to encounter sooner or later the phenomenon, science.

The historical analysis will also explain the frustrations of science. Why is it that in times of war we are willing to make free use of science, while as soon as peace is achieved we refuse, or so far at least have refused, to apply principles of science to the basic processes of social life, to production, distribution and consumption?

If the teaching of history is to be more than an intellectual recreation, if it is meant to help young people to understand the world in which they live and to play their part in it intelligently, it must by necessity include the history of science, which must become an integral part of all phases of historical instruction.

To-day universities only, and only a few, offer instruction in the history of science, but I feel very strongly that in postwar education the teaching of the history of science should begin in the primary school. At that stage the biographical approach may be the most appropriate. Children are interested in nature and in technology; the story of the great scientists and of their discoveries, presented in simple terms, would be most inspiring. I first heard the name of Benjamin Franklin in my French school when I was seven years old. Our teacher, an old lady—she may not have been so old, but to us she seemed so—told us about the great American who had come to France, and she described his experiments with a kite and his invention of the lightning rod. She also told us about his stove. We were so impressed that although it was a very long time ago, I remember that class as vividly as if it had been yesterday. And we never flew kites without thinking of Franklin. When we were struggling with the multiplication table we heard about Pythagoras because in France the multiplication table is called *la table de Pythagore*. Later at the age of about ten, we learned a great deal about Linnaeus because we were gathering plants and were grouping them according to families. We built a sundial in the school garden as the Babylonians and Chinese had done thousands of years ago.

To-day boys and girls are very keen on building airplanes. This presents a great opportunity to tell them about Leonardo da Vinci. I am sure that a

[2] There may be another reason why statesmen often distrust historians. They know that sooner or later they will have to appear before the tribunal of history and that the judgment of just such historians will determine whether their descendants will be proud or ashamed of them.

class devoted to Leonardo with lantern slides showing some of his machines and also his paintings would make a lasting impression on children. And the history of flying from Leonardo to the Wright brothers makes a fascinating story.

Much history of science can be taught in the primary school in such an informal way. It not only adds color to the teaching and is inspiring, but also gives young people a certain historical perspective and respect for the past. They come to realize that it is not accidental that they enjoy the fruits of science, but it is the result of the labor and genius of generations of men who preceded them.

In high school, instruction will be more systematic. One may consider giving a special course in the history of science wherein Sir William Cecil Dampier's new book, "A Shorter History of Science" (New York: Macmillan, 1944), will be found equally useful by teachers and students. I hear that in England the introduction of the subject into the curriculum of the grammar school is being considered very seriously.

Whether a special course is given or not, the history of science should, in the secondary school, become an integral part of the teaching of history as well as of science. In other words, a study of ancient history should not be limited to the history of political events and economic conditions, but should also picture the development and the contributions of ancient civilization of which science was an essential part. A history of Elizabethan England that ignores science remains fragmentary by necessity. A certain knowledge of Elizabethan science is needed for the mere understanding of Shakespeare's plays. Good examples of historical text-books that include science, at least to a certain extent, are James H. Breasted's "Ancient Times, a History of the Early World" and Carl L. Becker's "Modern History, The Rise of a Democratic, Scientific and Industrialized Civilization."

The teaching of science, on the other hand, can gain a great deal if the historical approach is used as a didactic method. The teacher will soon find that there is no better way of making complicated matters clear to the student than by presenting the subject genetically. The history of oxidation discussed in a course of chemistry or the history of the circulation of the blood in a biology course enables one to explain and clarify a great many basic concepts. And in presenting a subject historically, the science teacher can draw the attention of his students to philosophical problems. He can impress upon them that physics and chemistry are not a collection of rules and formulae but are an attempt to understand and interpret nature.

The need for instruction in the history of science in colleges is so obvious that it hardly requires any elaboration. If the purpose of the undergraduate school is to give young people a broad general education and to help them to understand the world in which they live and in which they are called upon to play a part, the course must include both the humanities and the sciences.

Students as a rule feel more attracted to one or the other field, and many enter school having a definite major subject in mind whereby they are inclined to neglect the other fields. It should be impressed upon them, however, that science and the humanities are not two separate worlds. In the past, philosophy was the connecting link, and there is no reason why it should not be to-day. Unfortunately many professional philosophers have developed an ivory tower attitude and a language that nobody understands who does not belong to the brotherhood. They have lost contact with the realities, and thus have lost their grip on students. The history of science that combines the humanities, the social and the natural sciences, and is philosophic in outlook could to a certain extent fill the gap and take the place in college education that philosophy once held.

I think that every college should make an effort to provide not only some but competent and thorough instruction in the field. Courses should be supplemented by seminars in which the students would be encouraged to read and study texts, classics of science. Unfortunately we have not a series of classics comparable to Ostwald's "Klassiker der exakten Naturwissenschaften," but many texts are available in English translation. We also have intelligent text-books such as Sir William Cecil Dampier's "A History of Science and its Relations with Philosophy and Religion" (Cambridge, 3rd ed., 1942) and Charles Singer's "A Short History of Science to the Nineteenth Century" (Oxford, 1941).

In the graduate school, finally, the history of science has an extremely important function to fulfill. The graduate school is training specialists, physicists, chemists, bacteriologists, engineers, physicians, etc. Knowledge has accumulated tremendously in science with the result that every scientific discipline has become extremely complicated and specialized. The danger is obvious that we train mere technicians, men highly competent and highly skilled in one limited field of science but unaware of the social function of science and unprepared to play their part as citizens.

At the time of the great depression, I was once standing on the Grand Coulee Dam while it was under construction and was shown around by an agricultural engineer. Pointing to the waste land, he gave me a glowing picture of how irrigation would turn this desert into a flourishing garden, how at my next

visit I would find miles and miles of the finest orchards producing the best fruit in the world. When I asked quite naively who was going to eat this fruit, his answer was, "That's none of my business." The thought had never occurred to him that the fine fruit produced by so much labor and skill might be left rotting on the trees because so far we had been unable to organize distribution and consumption along scientific lines. And yet he was a citizen of a democracy who had had the best possible education, whose voice might have been very influential.

To-day when science is having such a strong impact upon the life of society, the scientist can no longer afford to remain cloistered in his laboratory and let the world be damned. He must assume responsibilities toward the community and must take an active part in determining the destinies of the nation. This, however, requires a broader training than he had in the past. Instruction in the history, sociology and philosophy of science by teaching him humanities and social sciences in a language he understands, will open his eyes to many problems and will undoubtedly contribute toward making him a better scientist and a better citizen.

The graduate school is also training historians, philologists, philosophers, economists, sociologists who must have some knowledge of science and must be familiar with its history. The historian of science who is both scientist and historian is best prepared to interpret science for them, presenting it in a language they understand.

The great educational value of the history of science is gradually being recognized, in England probably more than in the United States. But in this country, more and more educators are also beginning to realize that education at all levels can be broadened and enriched considerably by giving history a more prominent place in the curriculum and by including the history of science.

The war has ruthlessly destroyed many values; but just as it has cleared slums and made room for better housing, it has also cleared or at least exposed educational slums and has opened the way for improvements. It is to be hoped that in planning for postwar education, the men who are at the head of our great institutions of learning will avail themselves of the opportunities that the history of science offers for training the citizens of to-morrow.

OBITUARY

SIMON HENRY GAGE

SIMON HENRY GAGE, emeritus professor of histology and embryology, Cornell University, Ithaca, N. Y., died at his home in Interlaken, N. Y., on October 20, 1944, at the age of 93 years. He collapsed in his laboratory on October 11 and thus ended a long career of continuous devotion to his university and to his favorite field of science.

Professor Gage was born in Otsego County, N. Y., on May 20, 1851. After a brief career as an itinerant photographer he entered Cornell University as a freshman in 1873. Upon graduation in 1877 he became an assistant in the department at Cornell, then embracing all there was of animal biology, under the direction of Professor Burt G. Wilder. With the recognition of his ability his rise was rapid: instructor, assistant professor, associate professor to associate professor of anatomy, histology and embryology and finally professor of microscopy, histology and embryology, subsequently designated professor of histology and embryology.

With the founding at Cornell University in 1896 of the New York State Veterinary College, he was made head of an independent department housed in that college. In 1901, three years after the establishment of the Cornell University Medical College, Professor Gage moved to the newly erected Stimson Hall, which has been his scientific home ever since.

In 1908 under a special grant from the Carnegie Foundation, he retired that he might devote his whole time to research. This he continued to do until his death. His last published scientific article bears the date of 1942. On the ninetieth anniversary of his birth, May 20, 1941, appeared the seventeenth edition of his well-known book, "The Microscope." At the time of his death he had completed a book, "The History of the Comstock Publishing Company" and was completing a work on the "History of Microscopy in America." The microscope and its use—a first love of Professor Gage—thus retained a high place until the end. His interest in biology and its problems was, however, broad, as may be seen by consulting the list of nearly 200 articles, books and reviews from his pen.

His published work brought him merited recognition from the scientific world. He was twice president of the American Microscopical Society and twice presided over the meetings of the Zoological Section of the American Association for the Advancement of Science. Professor Gage was one of the original members of the American Association of Anatomists when it was established in 1888 and until recent years took an active part in its proceedings. When in 1901 the *American Journal of Anatomy* was founded, he helped in its establishment and became a member of its editorial staff. When the Wistar Institute of

Anatomy and Biology was reorganized in 1905 and took over, among others, the responsible publication of the *Journal of Anatomy,* Gage was chosen a member of the original Wistar Advisory Board and for many years had a part in the formulation of Wistar policies. As an expression of appreciation the forty-eighth volume of the *Journal of Anatomy* was dedicated to him at a dinner in his honor on his eightieth birthday.

As a teacher, Professor Gage was thorough and exceptionally careful that his statements, illustrations and demonstrations were clear and pertinent. His teaching revealed most clearly his characteristics as a man. Throughout his life he exhibited for his work the enthusiasm characteristic of youth; indeed, he never really grew old. Ever appreciative of the importance for science of instruments of precision, he keenly realized that most important of all to perfect was the student of exceptional ability. His advice and encouragement were freely given to students and to colleagues who often consulted him. Many thus came to know him and gained a deep affection for him. Perhaps the most concrete expression of appreciation and affection was the establishment at Cornell University of a graduate fellowship in his honor. The fund for the Simon Henry Gage Fellowship in Animal Biology was first presented to the university at a dinner in honor of Professor Gage on his sixty-fifth birthday and effectively completed by the ninetieth birthday, when he was again feted as dinner guest of his friends and colleagues.

Possibly to the undersigned more than to others has it been granted—through a period of fifty years as graduate student, assistant, colleague and successor—to know the sterling and lovable character of Professor Gage; his high ideals and earnest desire to help his fellow men which took many forms. Some will look back through the years to words of helpful advice, the hospitality of his home or financial aid in times of stress.

Many mourn his passing, but the memory of his thoughtful kindness remains.

B. F. KINGSBURY

DEATHS AND MEMORIALS

THOMAS MIDGLEY, JR., of Worthington, Ohio, president of the Ethyl Gas Corporation, president of the American Chemical Society, died on November 2 at the age of fifty-five years.

T. M. OLSON, since 1920 professor of dairy husbandry at the State College of South Dakota at Brookings, died on October 25 at the age of sixty years.

DR. ALEXIS CARREL, of Paris, from 1912 to 1939 member of the Rockefeller Institute for Medical Research, died on November 5 at the age of seventy-one years.

THE death is announced of I. Huang, professor of psychology at the National University of Chekiang, Tsunyi, Kweichow, China.

As a tribute to the memory of Stephen Moulton Babcock, who conducted important research in the field of dairying, the Board of Regents of the University of Wisconsin has voted to place a special plaque of commemoration on his monument.

SCIENTIFIC EVENTS

THE WABASH VALLEY SECTION OF THE AMERICAN CHEMICAL SOCIETY

THE organization of a new local section of the American Chemical Society composed of chemists of the Wabash Valley has been announced by Dr. Charles L. Parsons, national secretary of the society.

H. V. Fairbanks, assistant professor of chemical and metallurgical engineering at the Rose Polytechnic Institute, has been chosen chairman of the new unit, which has been officially chartered by the council of the society as the Wabash Valley Section, with headquarters in Terre Haute. Other officers are Carl W. Frerichs, works manager of the Crescent Products Company, *vice-chairman;* Esther A. Engle, of the Commercial Solvents Company, *secretary,* and Dr. Richard S. Egly, also of the Commercial Solvents Company, *treasurer,* all of Terre Haute. The section was organized in recognition of the growing importance of Wabash Valley as a chemical area.

The Wabash Valley Section constitutes a professional group of chemists who were formerly enrolled in the Indiana Section and in the section of the society at the University of Illinois. Its territory takes in the counties of Clay, Knox, Parke, Sullivan, Vermillion and Vigo in the State of Indiana, and the counties of Clark, Crawford, Edgar and Lawrence in the State of Illinois. The charter members, all actively identified with the chemical industry and with chemical education, number one hundred and four.

Early in 1943, the Wabash Valley chemists formed the Terre Haute Branch of the Indiana Section under the chairmanship first of A. W. Campbell and later of John M. Geisel. Dr. Jerome Martin, councilor of the Indiana Section, acted as representative of the chemists in obtaining the charter for the new local section, which was granted by the council of the society.

The chemical profession of Wabash Valley includes

a wide range of chemical interests. Institutions, firms and government agencies represented in the membership are:

Standard Brands, Inc.; E. I. du Pont de Nemours & Company, Inc.; Commercial Solvents Corporation; Tennessee Eastman Corporation; War Department; Ohio Oil Company; Indian Refining Company; Aluminum Company of America; State of Illinois, Division of Highways; Western Cartridge Company; U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine; U. S. Army, Sanitary Corps; U. S. Army, Engineering Corps; U. S. Army, Chemical Warfare Service; Crescent Products Company; Cereal Mills, Inc.; Ayrshire Patoka Collieries Corporation; The Texas Company; Quaker Maid Company; Wabash Products Company; Merchants Distilling Corporation; Smith-Alsop Paint and Varnish Company; Velsicol Corporation; Carnegie-Illinois Steel Corporation.

Representation also embraces the Rose Polytechnic Institute, the Indiana State Teachers College, St. Mary-of-the-Woods College and the Wiley High School, Terre Haute. Monthly meetings to be addressed by leading men of science are planned. Addresses and discussions will deal with the development of science and industry and with the roll of chemists and chemical engineers in world affairs.

THE ANNUAL REPORT OF THE PRESIDENT OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Plans for immediate development of special laboratories for intensive research in electronics and new methods of propulsion, including gas turbines and jet engines, are planned at the Massachusetts Institute of Technology, according to the annual report to the corporation of President Karl T. Compton. Establishment of a division of food technology is also planned as a post-war development. Funds have been appropriated for research on the mechanics of materials and in the field of applied mathematics, and provision has been made for a new hydraulics laboratory in the near future.

While the nature of the war research in progress at the institute can not for reasons of security now be made public, it is stated in the report that the volume of war projects this year has reached a value of $25,000,000, an increase of $9,000,000 over last year, and the overall program of the institute is being carried on by a staff of five thousand five hundred research specialists and employees.

According to the report

the devices developed have contributed importantly to success on every front and on every sea, and their commercial war production has run into exceedingly large figures. Staff members have held high advisory, executive and operative posts in the technological war organization all the way from the United States to the southwest Pacific in one direction and to the European theater and Russia in the other.

Aside from research and the work of its staff in the war, the institute has carried on a very large war training program for Army, Navy, Air Force and civilian personnel. In a few important fields it has been the only or the principal training center in this country. In other fields it has taken its share with many sister institutions.

In summarizing the post-war program it is stated that approximately $4,000,000 will be required for additions to the plant and about $1,000,000 a year for the increased budget.

Dr. Compton writes:

We can not fail to recognize some very serious problems facing us and all other educational institutions and many other bulwarks of our society in the years to come. The devaluation of the dollar, some years ago, the significant increase in the cost of living during the past four years, the heavy increase in taxation, and the decreased yield on invested funds, all impose unprecedented handicaps to activity in the near future. In addition to electronics, propulsion and food technology, other fields which offer exceptional opportunities for post-war industrial development are plastics, organic chemistry and special instruments, in which great progress has been made during the war; mechanisms for controlling machinery, calculating machines, the mechanics of materials, hydraulics and applied mathematics.

THE AMERICAN SOCIETY OF NATURALISTS

At the meeting of the American Society of Naturalists held in Cleveland on September 14, the following officers were elected:

President, Edmund W. Sinnott, Yale University.

Vice-president, K. S. Lashley, Harvard University.

Treasurer, T. M. Sonneborn, Indiana University, for three years.

The *Secretary*, W. R. Taylor, University of Michigan, continues two more years in office.

New Members elected at this meeting were: J. B. Buck, University of Rochester; G. L. Cross, University of Oklahoma; M. Delbrück, University of Tennessee; B. Ephrussi, the Johns Hopkins University; K. Esau, University of California (Davis); G. L. Graham, Rockefeller Institute (Princeton); I. M. Johnston, Harvard University; D. H. Linder, Harvard University; P. A. Munz, Cornell University; G. Pincus, Clark University; A. Tyler, California Institute of Technology; F. Verdoorn, Waltham, Mass.

As *Honorary Members* were elected: R. G. Harrison, Yale University; F. R. Lillie, University of Chicago, and G. H. Parker, Harvard University. Each has served as president of the society and in other ways, and all joined the society before 1900.

AWARD TO COLONEL BRADLEY DEWEY OF THE CHEMICAL INDUSTRY MEDAL

Colonel Bradley Dewey, president of Dewey and Almy Chemical Company, Cambridge, Mass., in 1943

U. S. Rubber Administrator, has been awarded the Chemical Industry Medal for 1944 for outstanding achievement in the application of chemical research to industry of the American Section of the Society of Chemical Industry.

Colonel Dewey is cited "for his work in colloid chemistry, especially as relating to rubber latex, and his accomplishments in administering the synthetic rubber program during the critical war period."

The presentation of the medal takes place at a meeting at the Hotel Roosevelt on the evening of November 10, under the joint auspices of the American Section of the Society of Chemical Industry, the New York Section of the American Chemical Society and the American Institute of Chemical Engineers.

The program includes an address by Colonel Dewey on "The Role of Organized Research and Business in American National Defense"; by Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, on "The Medalist's Part in Educational Matters"; by Dr. Vannevar Bush, head of the Office of Scientific Research and Development, on "The Scientific and Technical Accomplishments of the Medalist"; and by Charles Almy, vice-president of the Dewey and Almy Chemical Company, on "The Personal Side of the Medalist." Dr. Foster D. Snell, head of Foster D. Snell, Inc., Brooklyn, makes the presentation.

SCIENTIFIC NOTES AND NEWS

The gold medal for distinguished service in medicine of the New York Academy of Medicine was presented on October 5 to Dr. Oswald Avery, emeritus member of the Rockefeller Institute for Medical Research, in recognition of his investigations that "have led to discoveries and great advances in the science of bacteriology."

Dr. Roscoe R. Spencer, of the U. S. Public Health Service, chief of the National Cancer Institute, was presented with the Clement Cleveland Award for 1944 at a recent meeting of the New York City Cancer Committee.

Dr. Maximilian Toch, president and chief chemist of Toch Brothers, was the guest of honor at a testimonial dinner tendered to him on October 27 by the New York Chapter of the American Institute of Chemists at which he was presented with a certificate of honorary membership in the institute. The speakers at the dinner included Dr. Gustav Egloff, of the Universal Oil Products Co., president of the institute; George Baekeland, president of the Bakelite Corporation, and Dr. Marston T. Bogert, professor of organic chemistry, emeritus, of Columbia University. Dr. Marston L. Hamlin, of the Allied Chemical and Dye Corporation, chairman of the New York Chapter, presided.

L. M. Pidgeon, head of the department of metallurgical engineering of the University of Toronto, has been awarded by the board of governors of the university the McCharles prize of $1,000 in recognition of his development of a process for the production of magnesium from dolomite.

A dinner in honor of Dr. Torald H. Sollmann, professor emeritus of pharmacology and dean of the School of Medicine of Western Reserve University, was tendered to him on September 25 by the faculty and alumni. He was presented with a silver plaque in recognition of his distinguished services to the school with which he has been connected for nearly fifty years.

At the graduation ceremonies on October 28 of the Stevens Institute of Technology, honorary degrees were conferred on Dr. A. Allan Bates, manager of chemical and metallurgical research of the Westinghouse Electric and Manufacturing Company at Pittsburgh; on Professor Arthur Phillips, professor of metallurgy at the Sheffield Scientific School of Yale University, and, as reported in Science last week, on Dr. Robert F. Mehl, director of the Metals Research Laboratory of the Carnegie Institute of Technology.

Dr. G. A. Talbert, for twenty years the head of the department of physiology and pharmacology of the Medical School of the University of North Dakota, has been made emeritus professor. A special convocation was held on October 25, at which time the honorary degree of doctor of science was conferred on him. Dr. A. J. Carlson, emeritus professor of physiology of the University of Chicago, president of the American Association for the Advancement of Science, was the guest speaker.

Albert Parsons Sachs, consulting chemical engineer, was elected on October 24 president of the Association of Consulting Chemists and Chemical Engineers at the annual meeting of the association held in New York City.

Dr. William L. Everitt, of the Ohio State University, chief of the Operational Research Branch, Office of the Chief Signal Officer of the United States Army, has been elected president of the Institute of Radio Engineers for the coming year. He succeeds Professor Hubert M. Turner, of the department of electrical engineering of Yale University. Dr. Everitt,

who since 1942 has been directing research for the Army at Washington, was recently appointed professor and head of the department of electrical engineering at the University of Illinois, but was granted leave of absence to enable him to continue his work for the Army. Dr. Hendrik J. Van der Bijl, of Johannesburg, Union of South Africa, fellow of the institute since 1928, has been elected vice-president.

THE Paris Academy of Sciences on October 12 elected to membership Prince Louis de Broglie, Professor Pasteur Vallery-Radot and M. André Siegfried. M. Georges Duhamel, acting secretary, was elected *secrétaire perpetuel.* A correspondent of *The Times,* London, writes: "Professor Vallery-Radot, who was celebrated before the war for medical research, won new fame during the occupation as the organizer of the medical service of the resistance movement under the name of Monsieur Renoir. He had been in hiding from the autumn of 1943 until the liberation. He is a grandson of Pasteur."

DR. T. S. PAINTER, research professor of zoology at the University of Texas, has been made acting president of the university.

DR. PAUL R. PATEK has leave of absence for a year from the University of Southern California to enable him to become visiting associate professor of anatomy at Washington University, St. Louis.

PROFESSOR FRANK ALLEN, head of the department of physics at the University of Manitoba, has retired after serving for forty years.

DR. WILLIAM H. COWLEY, who recently resigned from the presidency of Hamilton College, has been appointed professor of education at Stanford University. Before becoming president of the college, Dr. Cowley was professor of psychology at the Ohio State University.

DR. IRA L. BALDWIN, professor of bacteriology and head of the department at the University of Wisconsin, has been appointed dean of the Graduate School. He succeeds Professor Harold W. Stoke, acting dean, who was recently elected president of the University of New Hampshire. Dr. Baldwin during the past year has had leave of absence to enable him to undertake war work in Washington. After December, however, he will devote full time to work at the university.

DR. ARNOLD J. LEHMAN, of Wayne University College of Medicine, Detroit, has been appointed professor of pharmacology at the School of Medicine of the University of North Carolina.

DR. ALEXANDER J. ALLEN, assistant director of the Biochemical Foundation of the Franklin Institute at Newark, Del., has been appointed Westinghouse graduate professor of engineering at the University of Pittsburgh. Dr. Allen will work closely with the Westinghouse Educational Department in planning a series of courses leading to advanced degrees for company employees.

DR. C. A. MACE, university reader in psychology at Bedford College, University of London, has been appointed to a professorship at the Birkbeck College of the university. At the College of the Pharmaceutical Society, H. Berry has been appointed professor of pharmaceutics and Dr. W. H. Linnell, professor of pharmaceutical chemistry. Dr. Frank Goldby, since 1937 Elder professor of anatomy at the University of Adelaide, has been appointed to the university chair of anatomy tenable at St. Mary's Hospital Medical School.

DR. HANS F. JENSEN, formerly with the Research Laboratories of the Upjohn Company, Kalamazoo, Mich., has accepted a position as director of research with the Des Bergers-Bismol Laboratories in Montreal, Canada.

DR. TREVOR LLOYD, professor of geography at Dartmouth College, has leave of absence for a year to undertake a war-time assignment for the Canadian government in Godthaab, Greenland. He has now in preparation a report for the Canadian Institute of International Affairs on the post-war development of northern Canada.

DR. J. T. STARK, chairman of the department of geology and geography of Northwestern University, has had leave of absence since April, 1943. He holds the rank of Major in the Army Air Forces and is connected with the Arctic, Desert and Tropic Information Center at Orlando, Fla.

DR. A. L. HOWLAND and Dr. R. M. Garrels, of the department of geology and geography of Northwestern University, have leave of absence to enable them to engage in special research in Washington.

SIR JOSEPH BARCROFT, Sir Harold Hartley and Sir Frank Smith retired on September 30 on completion of their terms of office as members of the Advisory Council of the British Privy Council for Scientific and Industrial Research. They are succeeded by W. J. Drummond, Dr. H. L. Guy, Sir William Halcrow and W. F. Lutyens.

THE *Journal* of the American Medical Association reports that five Chinese professors recently arrived in England as guests of the University of Oxford and the University of Cambridge. They include Chang Tsu-King, professor of the history of science at the University of Central China, who will work at Christ's College, Cambridge, and Yin Hung-Chang, professor

of plant biochemistry at the Associated Southwestern Universities (Tsing Hua), Kunming, who will engage in research in plant biochemistry at St. John's College.

Carl B. Palmer, associate physicist for the National Advisory Committee on Aeronautics at Langley Field, presented on October 13 an illustrated lecture on "Jet Propulsion" before the V-12 and civilian students at Miami University. The lecture was under the joint auspices of the societies of Sigma Xi and Sigma Pi Sigma.

Dr. Carl F. Schmidt, professor of pharmacology at the School of Medicine of the University of Pennsylvania, made an address on October 12 at the meeting of the American Society of Anesthetists at the New York Academy of Medicine. He spoke on "The Newer Concepts of Respiratory Control."

The Electrochemical Society will meet in Atlantic City on April 12, 13 and 14, 1945. Three sessions are planned as follows: Electronics, Dr. M. E. Fogle, chairman; Theoretical Electrochemistry, Dr. J. F. Gall, chairman, and Corrosion, Dr. H. H. Uhlig, chairman. To insure pre-printing, manuscripts for the spring convention must reach the society not later than December 15.

Application forms are now available for the Frank B. Jewett Fellowships and may be obtained from the Frank B. Jewett Fellowship Committee, Bell Telephone Laboratories, 463 West Street, New York 14, N. Y. These fellowships are for post-doctorate research in the fundamental physical sciences, including chemistry, mathematics and physics. Each fellow will receive $3,000 and the institution where his work is done will receive $1,500. Applications should be received by the committee before January 1, 1945; announcements of awards will be made on March 1. Applicants whose present remoteness makes it appear impracticable to obtain and return an application before the closing date may apply by letter. This should contain a brief biographical statement, information as to education and previous professional work, a report of research completed or in process, a discussion of the research which the applicant proposes to pursue if appointed and the name of the institution where he would work. Names should be furnished of three or four individuals, to whom the committee might turn for references regarding his scientific qualifications and potentialities.

Applications for research fellowships in medicine, dentistry and pharmacy in the University of Illinois are now being considered for the year beginning September 1, 1945. Appointments to these fellowships will be announced on April 1, or before. Candidates must have completed a training of not less than eight years beyond high-school graduation. The fellowships carry a stipend of $1,200 per calendar year with one month's vacation. Application blanks and further information may be secured from the Secretary of the Committee on Graduate Work in Medicine, Dentistry and Pharmacy, 1853 West Polk Street, Chicago 12, Illinois.

At the close of the war Cornell University plans to increase to five years courses in civil, electrical and mechanical engineering leading to the bachelor's degree. Courses in chemical engineering have been since 1938 on a five-year basis.

The sum of $5,000 for cancer research in addition to $15,000 previously given has been received by the University of Chicago from R. T. Miller, of Scottsville, N. Y., and Chicago, as a memorial to his brother, O. C. Miller.

The Illinois Institute of Technology and the Allis-Chalmers Manufacturing Company of Milwaukee are cooperating in a plan to offer courses leading to the master's degree in electrical and mechanical engineering to ninety-five students of engineering, employees of the company. The curriculum is so planned that the average student can obtain the degree within four years, at the same time carrying on full-time employment. The project was organized at the request of Allis-Chalmers under the leadership of Dr. J. E. Hobson, director of electrical engineering at the institute and representative of the committee on graduate study. Many of these employees are men of middle age who hold responsible engineering positions and are said to welcome the opportunity to bring their knowledge of industrial developments up to date. The company pays a third of the tuition costs of each student and if the course is satisfactorily completed contributes an additional third.

DISCUSSION

UNE FAUTE DE TRANSCRIPTION, D'ORTHOGRAPHE, OU D'IMPRESSION

Comments made by some authors[1] have shown that they understand that Article 19 of the International Rules of Zoological Nomenclature demands, without permitting corrections except for "mechanical errors,"

[1] J. B. Knight, *Amer. Jour. Sci.*, 239: 312–315, 1941; W. F. Rapp, Jr., Science, 99: 345; 100: 124, 1944.

that the original orthography of the names of animals must be rigidly adhered to, even when a mistake is evident. They admit no alternative to perpetuation in zoological nomenclature of certain names of the sort that Dobell[2] called "monstrous Latin parasites." Article 19 permits change of the first-printed form of the name when "an error of transcription, a *lapsus calami,* or a typographical error is evident." When the discussion that has centered around that article is read it is apparent that there has not been uniformity in understanding of its meaning. The pertinent Opinions rendered by the commissioners, acting upon their own understanding of Article 19, constitute a valuable commentary.

An instance of typographical error appears in a paper by Rondani[3] where the name of the sandfly is given *Hebotomus.* That appears to be a typesetter's mistake for *Flebotomus,* even though it appears many times and no other spelling is given in that paper. In Opinion 27, the commissioners denominated "typographical error" the original author's failure to use the correct spelling of the name of a man to whom he dedicated a genus; and a case of incorrect ending of a specific name printed "accidentally, ignorantly, or inadvertently" is referred to in Opinion 60 as a *lapsus calami* or typographical error. The meaning of "typographical error" that is understood in these Opinions apparently covers what Brues[4] intended by the term, though a more precise definition seems to be desirable.

Although the Opinions deal with various kinds of orthographical matters, including incorrect spelling of patronymics and inaccurate rendering from Greek into Latin, it is only in Opinion 36 that I have found a mistake to be termed an error of transcription. That Opinion is concerned with an instance of transliteration from Greek, and in the discussion of it, as well as in the summary, transliteration is given as a word to be understood within the meaning of the term transcription in Article 19. The commission has accepted corrections in transliteration both in the Opinions and in the Official List of Generic Names. The word transcription is defined in the Oxford English Dictionary as meaning both the act or process of copying *and* transliteration. In the absence of any statement to the contrary it is probably not proper to assume that acceptance of that definition is not within the basic purpose and philosophy of Article 19, or of the conception of zoological nomenclature which that article represents.

In one Opinion (41) *lapsus calami* is the wrong spelling of a word both in its Greek and Latin form; in one (61) it is used in connection with a case of transliteration ("confusion of diphthongs," in remarks by Bather); and in another (70) it is an inadvertent inclusion in a binominal of the wrong generic name. This last use of the term *lapsus calami* does not seem to come within the scope of orthography, with which Article 19 deals, and it appears particularly inappropriate when the French wording of that article is considered.

Dobell[5] pointed out that *"lapsus calami* is an incorrect translation of "faute . . . d'orthographe," and the International Commission itself has recently published the statement (in Opinion 148, 1943) that "in any case of doubt the French text is the substantive text and the other texts are to be treated as translations." Dobell expressed agreement with the comment by Cossmann[6] in interpreting Article 19 as not only permitting but requiring correction of obvious errors in the spelling of names.

Codes of nomenclature have grown out of sets of rules and recommendations proposed chiefly in the nineteenth century, and it is interesting to examine the position of the earlier nomenclaturists with regard to changes in spelling. The report made in 1842 by Strickland and the other members of a committee of the British Association[7] recognized the right to correct erroneously written names. Agassiz recognized the desirability of correcting errors of orthography, and he made[8] a large number of emendations of generic names, among them correction of *Flebotomus* to *Phlebotomus.* The report by Dall[9] also admitted the right to correction. Formulation of the International Rules of Zoological Nomenclature was inaugurated by Chaper's report (1881) in the name of the Commission of Nomenclature of the Société Zoologique de France and Blanchard's report to the International Congress of Zoology at Paris (1889). These reports stated that "Tout barbarisme, tout mot formé en violation des règles de l'orthographe, de la grammaire, et de la composition devra être rectifié." In the Règles de la Nomenclature des Êtres organisés adopted by the Paris Congress the part about these corrections was not included. Article 41 of the rules drawn up by the International Commission of five members appointed at the Leyden Congress in 1895[10]

2 C. Dobell, *Parasitology,* 31: 255, 1939.
3 C. Rondani, *Ann. Soc. ent. France* (2), 1: 263, 1843.
4 C. T. Brues, SCIENCE, 99: 427, 1944.

5 C. Dobell, *Parasitology,* 31: 256, 1939.
6 M. Cossmann, *Rev. crit. Paléo.,* 18: 152, 1914.
7 *Rep. Br. Assoc.,* 1842: 105–121.
8 L. Agassiz, "Nomenclatoris Zoologici Index Universalis," Soloduri, 1846.
9 W. H. Dall, *Proc. Am. Ass. Adv. Sci.,* 26: 7–56, 1878.
10 "Régles de la Nomenclature Zoologique proposées au Congrès de Cambridge par la Commission internationale," *Bull. Soc. zool. Fr.,* 22: 173–185, 1897.

reads: "Toute faute grammaticale doit être rectifiée." This report was to have been presented to the Cambridge Congress in 1898, but it was not received, and a new report was later prepared by a commission enlarged to 15 members. When the Rules were published in the proceedings of the Berlin Congress of 1901 the article about orthography had been changed for one worded in much the same form as Article 19 of the present code. In its French wording the article of the Berlin Congress reads: "L'orthographe originelle d'un nom doit être conservée telle que son auteur l'a donnée, à moins qu'il ne soit évident que ce nom renferme une faute de transcription, d'orthographe ou d'impression."

The Code of Nomenclature adopted by the American Ornithologists' Union[11] deals with the subject of orthography in a very definite way. It is stated that the words used as names of genera and subgenera are of no definite construction, and are not to be rejected for faulty construction; and it is remarked that all that relates to grammatical and philological proprieties is not necessarily pertinent to zoological nomenclature. Variants of names resulting from emendation by "purists" are considered untenable, and a canon of the A. O. U. Code directs that the original orthography of a name is to be rigidly preserved unless a typographical error is evident, and with the exception that certain changes may be made in the termination of specific names. This rigid position is that taken by those who have expressed the first point of view considered in this article. But whereas this position has firm support, if not a source, in the A. O. U. Code, and in other sets of regulations adopted by limited groups of zoologists, its proponents often state or imply that the International Rules of Zoological Nomenclature constitute their authority. Whether or not that is now so is a question for the International Commission to decide; careful study of the record does not, it seems to me, sustain the interpretation.

Strict application of priority in orthography, good or bad, without regard to any philological or other consideration, could result in changes in the customary spelling of such names as *Ancylostoma* (originally *Agchylostoma,* but now placed in emended form in the Official List of Generic Names); *Trichomonas* (originally *Tricomonas,* but favored by the Commission in emended form); *Amoeba* (originally *Amiba*); *Chlamydomonas* (originally *Chlamidomonas*); *Condylostoma* (originally *Kondyliostoma*); *Haplosporidium* (originally *Aplosporidium*); *Strombidium* (*Strombidion* having page priority in the original publication); *Liponyssus* (originally *Liponissus*); and, one may add, *Phlebotomus* (originally *Flebotomus*).

[11] New York, Amer. Ornith. Union, 1908.

Would it be unreasonable to consider that, in following the recommendations under Article 8, a and b of the International Rules of Zoological Nomenclature, the Greek substantives or compound Greek words that we are authorized to take as generic names *are* those names? Then the necessary transliteration from the Greek alphabet to the Latin alphabet may be regarded as a second step, which follows selection of the original. If in that step an error of transcripiton (*seu* transliteration) is made, resulting in something that does not correspond to the original word, restoration of the original is appropriate to the most rigid insistence on priority. It must be plainly evident in the original publication what the original word is; that may be stated, but if not, in such cases as φλεβοτόμος it is also sufficiently clear. If a Latin word, a patronymic or a geographical name is selected, and an error is made in copying that word, it seems obvious that it is an error of transcription.

HAROLD KIRBY

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF CALIFORNIA,
BERKELEY

INCREASED CONTACT OF YOUNGER AND OLDER INVESTIGATORS IN RESEARCH LABORATORIES

DR. SEASHORE'S[1] timely proposal that more extensive facilities be made available to retired scientists is to be applauded. One aspect or rather one possible outgrowth of such a program deserves emphasis. Even if the older investigators continue their work, much is lost if they are no longer in contact with students. In many research institutions where increasing numbers of scientists might gather to continue their work, there is no student body. When there are no young investigators to pick up and carry on the numerous possibilities that develop from each established researcher's work, many ideas and techniques are lost.

From the point of view of the beginning investigator, the loss of contact with specialists is real and personal. More than ever, with the increasing complexity of special lines of investigation, students will want to amass a repertory of techniques before launching upon their own independent researches. Others, at some point in their work, will find a need for a new approach, whether it be via different methods or different ideas. There is an enormous loss of efficiency if each must seek out for himself what fragments he can by a laborious search of the literature or an occasional inquiry by letter. This is time-consuming

[1] SCIENCE, 100: 218, 1944.

and often fruitless. Negative results are rarely to be found, and the literature could not hold the myriad details of procedure and the rich flow of ideas that pass continuously between investigators working together.

The advantage is not one-sided. The younger investigators can carry on with dispatch those lines of research too numerous, too tedious or too strenuous for the senior scholars. We hope, too, that the students would bring with them a vitality and interest that would stimulate their teachers.

This program is definitely not conceived as a make-work or a post-war employment project, but it could at present serve effectively in reestablishing young scientists released from the armed forces. In a research-saturated environment they can more quickly catch up with new trends and suffer less from the incubus of forgotten techniques and unread literature. With particular regard to scholarships for returning service men, such a program is already under consideration for the Marine Biological Laboratory at Woods Hole. Here is an ideal situation for the biologist returning to take up individual research. Among the many investigators he could find an inexhaustible fund of information without being hampered by direct supervision. Others will prefer to work in some unified research project or along with some established investigator.

For the future, however, a plan to increase special research training must include the more normal trend, with funds and facilities continuously available, particularly to post-doctorate students and young instructors. Obviously this will require not only cooperation of research foundations and scientific institutions, but also a willingness of college administrations to allot adequate leave to the younger members of the faculty. They would all profit, not only from the heightened scientific stature of those trained, but more immediately from the energy and originality of youth.

IVOR CORNMAN

WASHINGTON, D. C.

TRANSMISSION OF TRYPANOSOMA EQUIPERDUM TO THE DUCK

A HIGH degree of specificity for certain hosts is recognized for many parasites. To test the possible transmission of a mammalian parasite to an avian host, mouse blood heavily parasitized with *Trypanosoma equiperdum* was injected intravenously into week-old ducklings. The parasite dose in each case was approximately 500 million organisms per kilo. Four groups of ducks followed for 8 to 12 days showed no microscopic evidence of parasites surviving in the peripheral blood. Two ducks followed for a longer time died on the 14th and 15th day, respectively. The latter showed a high parasitemia of very active organisms. These parasites appeared morphologically the same as those in the mouse. Five mice inoculated with blood from the duck developed fatal parasitemias on the 4th post-inoculation day.

Ten one-week-old ducks were inoculated intravenously and followed for a period of 18 days. Parasites could not be found in the peripheral blood by the 3rd day but reappeared in two birds by the 10th day. Fatal parasitemias developed in these on the 12th and 14th days. Blood from the 8 surviving ducks, showing no parasites after a careful search, was injected intraperitoneally into mice. All mice developed fatal parasitemias by the 8th day, showing all ducks to be harboring the parasite.

The implications of these findings as to possible avian reservoirs for similar mammalian parasites is obvious.

LLOYD D. SEAGER

DEPARTMENTS OF PHARMACOLOGY,
UNIVERSITY OF TENNESSEE
SCHOOL OF MEDICINE
WOMAN'S MEDICAL COLLEGE OF
PENNSYLVANIA

CRASPEDACUSTA IN MISSISSIPPI

ON August 14 numerous fresh-water medusae were observed in a concrete pool on the campus of Belhaven College in the city of Jackson. In early morning and late afternoon they were so abundant that the water at the west end of the pool was white. Specimens were collected at regular intervals and placed in large and small aquaria in both the Millsaps and the Belhaven laboratories. Some were preserved for further study. They disappeared from the pool on August 31 and from the aquaria five days later. Many of them did not mature.

The pool is 30×50 feet and is about 3 feet deep. It is supplied with water from the city main, and its water is lost only by evaporation. The flora of the pool consists of water lilies, Elodea and an abundance of algae on the sides and on the surface of the "ooze" at the bottom. Among the algae were numerous ciliates, rotifers, oligochaetes, nematodes, Bryozoa and flatworms.

The size of the medusae varied from 0.4 mm (youngest) to 10 mm in diameter. Numerous examinations revealed that all were males. The gonads of sexually mature forms varied in size, but all were very small after the spermatozoa were discharged.

The hydroid stage was found in scrapings of algae from submerged flower pots and from stems and leaves of water lilies, dead or alive. Hydroids were most abundant on small dead stems, but none grew on pine needles. When expanded they were 1.5 mm long and 0.2 mm in diameter. In the laboratory they produced medusoid buds until September 2.

These specimens are apparently *Craspedacusta ryderi* (Potts.) According to Schmitt's[1] summary of the American records of *Craspedacusta,* and a recent note from him, this is the first report of its occurrence in Mississippi. It is possible that the hydroids were brought here on some water lilies from Independence, Ohio.

John A. Fincher
Millsaps College
Kathryn S. Buchanan
Belhaven College

SCIENTIFIC BOOKS

MINERS' DISEASES

The History of Miners' Diseases: A Medical and Social Interpretation. By George Rosen, M.D. With an introduction by Henry Sigerist, M.D. New York: Schuman's. 490 pages. $8.50.

Dr. Rosen's book covers the history of metal and coal mining from the earliest records, of Egypt and Greece, down to the beginning of the nineteenth century. The forty-odd years of this century, with their important contributions to our knowledge of the diseases of metal and coal miners, are not covered, and since American contributions to industrial medicine belong to this later period, the reader will find no citations from American sources in Dr. Rosen's book, our interest in such matters having been slow to awaken.

We usually think of coal mining when we speak of mines, but metal mining was far more important up to the nineteenth century, when coal began to be mined on a large scale, but in England only. Copper, tin, lead, sulphur, gold and silver have been mined from earliest times and metal mining has always been far more dangerous than coal mining, because the ores are more likely to contain the harmful free silica. Then too, such metals as lead, quicksilver and manganese are poisonous, while others, such as copper and zinc, may be rich in arsenic, and any metal ore may contain less familiar but poisonous metals, such as cadmium, selenium, tellurium.

Dr. Rosen finds in the earliest writings on mining and in those of the Middle Ages descriptions of miners' diseases which show that those which we still regard as occupational were recognized and attributed to conditions in the mines. These are "miners' asthma," silicosis; "miners' consumption," silico-tuberculosis; metal poisoning; sudden death from fumes of sulphuretted hydrogen or carbon monoxide; anemia from hookworm infestation; deformities of the joints caused by unnatural posture; pneumonia from the sudden change from the heat of the mine to the cold, winter air; rheumatism, from the dampness, and miners' nystagmus, a rapid, involuntary oscillation of the eyeball.

In Greek and Roman days, miners were slaves or convicts who sometimes staged violent revolts, as when, in the Peloponnesian War, 20,000 Athenian slave miners went over to the Spartans. The richest mines acquired by the Romans were the silver, gold, mercury and copper mines of Spain. Diodorus tells us that the life of the miner was brief, but so terrible were the conditions of his life that death was preferable. The quicksilver mines of Almaden in Spain are still the richest in the world and there the metal occurs in pure form, so that the air is always full of poisonous fumes. According to the latest published report (DeKalb, 1921) the miners' working time is still kept down to eight days of four and a half hours each in a month, this being the only method devised to keep down mercurialism. Justinian wrote that a sentence to these mines was almost equal to a death sentence, and Plutarch criticized a mine owner because he employed in his mines slaves who were not criminals.

Throughout the Dark Ages mining suffered a decline, as did all industry, and there is no writing concerning it, but in the sixteenth century two very full descriptions appeared, one by Agricola (whose real name was Georg Bauer) and the other by that extraordinary man, Bombastus ab Hohenheim, or Paracelsus. Agricola sees the dust, water and stagnant air of the mines as causes for the wasting disease of miners, which carries off so many young men that he has known women in mining villages who had had seven husbands. Stirring up stagnant water may set loose a gas which causes instant death, (H_2S?); firing to break the rock face produces another deadly gas (CO?) so that the prudent miner does it only on Friday evening, to give time for the air to clear over the week-end. The miner's day in 1556 was only seven hours and his week only five days, but the conditions under which he worked were evidently deplorable. Agricola describes various kinds of nervous diseases, which probably were caused by arsenic. He also warns against demons of ferocious aspect which haunt the mines and can be driven out only by prayer and fasting. Paracelsus also recognized the air of the mines as the chief source of injury, though he called it "chaos" and wrote about it in his usual chaotic manner. However, he is the first one to write a monograph on the occupational diseases of a definite group of workers, for Agricola was more interested in labor and economics than in medicine.

These two stand out as the great figures in indus-

[1] W. L. Schmitt, *American Naturalist*, 73: 83–89, 1939.

trial medicine, with many followers, especially in Germany, but no rival till early in 1700 when the Italian Ramazzini brought out his great book on the "diseases of artificers." That Ramazzini's motive in taking up this almost unknown branch of medicine was primarily humanitarian he makes clear, for he was a man of warm emotions, filled with pity for the wretched lot of the worker, but he was also a scientist and approached the problems with curiosity and a scrupulous search for facts. He attributes miners' diseases to two causes, noxious fumes and particles in the air and the violent exertions and unnatural postures which the work makes necessary. He was also a pioneer in preventive medicine, he insists on ventilating devices and protective clothing, especially in arsenic mines. His book is an epitome of the knowledge of miners' diseases from antiquity to the eighteenth century.

Many interesting writings are brought to light by Dr. Rosen, such as Mattioli's description of chronic mercury poisoning among the miners of Idria in the first half of 1600. It was in Idria that the first recorded law was passed for the prevention of occupational disease, when in 1665 a six-hour day was made legal. Another remarkable description is that of Hoffman of Halle, who gave a clear picture of the pulmonary cancer of the miners in the Erzgebirge of Saxon Switzerland, cancer which we now know to be caused by radioactive ores. It was another German, Scheppler, who first distinguished clearly between miners' asthma, silicosis, and miners' consumption or phthisis, silico-tuberculosis, long before the discovery of the tubercle bacillus. Up to the beginning of the nineteenth century the greatest contribution to the study of miners' diseases, both clinical and pathological, came from Germany and such names as Virchow and Rokitansky are associated with it.

With the rapid increase of coal mining in England in the nineteenth century the English contributions began to take prominence. Coal had been mined as far back as 1217 when Henry the Third granted the Forest Charter, but it was used chiefly by smiths and lime burners and did not come into domestic use till the sixteenth century, after which the use gradually increased, then, with the dawning of the industrial era, underwent very rapid growth. Tin, lead and iron had been mined for centuries, and the Cornish tin mines seem always to have been notoriously deadly, owing, we now know, to the free silica in the ore. As coal pits increased in depth, the "enemies of the miner" began to appear, water, foul air, dust, poisonous fumes, falling timbers and land slides, and, worst of all, explosions of fire damp and dust. These last were spectacular enough to attract public attention and led to Parliamentary commissions of inquiry, with physicians as members. As one would expect, the attention of the English investigators was directed not only to dangerous conditions in the mines, but to the wretched homes of the miners, and we read less about the pathology of the pneumoconioses than about practical methods of clearing the air of the mines and bettering the lives of the men. William Thomson, an English physician, writing in 1858, insisted that the problem of miners' consumption could not be solved by medical means alone, engineering skill was needed and also correction of the social evils which contributed so much to the sickness of those workers. Britain started her admirable system of vital statistics in 1888 and from then on it was possible to demonstrate what mine work meant in terms of life and death, for the average life span of the miner was only 27.7 years, of the farmer, 42.3 years.

The last fifty years have seen great additions to our knowledge of miners' diseases. We have discovered the mode of action of free silica and we have a fairly accurate idea of how many particles of dust of a certain size constitute the danger limit in the air of a mine. Our diagnostic methods have improved enormously, these advances being due primarily to the work of a brilliant group of British physicians in the mines of the Rand, confirmed by Americans in the zinc-lead mines of the Tri-State region and the copper mines of Montana. This work remains for Dr. Rosen to describe in his second volume, as do also the discovery of asbestosis (English), the discovery of the cancer-producing action of radioactive ores (German), and the still controversial discovery of the inhibiting effect of aluminum dust on the formation of silicosis (Canadian).

ALICE HAMILTON

HADLYME, CONN.

ORGANIC CHEMISTRY

Organic Chemistry. By LOUIS F. FIESER and MARY FIESER. 6 × 9½ in. 1091 pp. Bound in blue cloth. Boston: D. C. Heath and Company. 1944. $8.00. Abridged edition, $6.00.

ORGANIC chemistry is a field of vast extent, whose boundaries have been for decades and are still expanding so rapidly in all directions that each year it becomes increasingly difficult, between the covers of a single volume, to give any adequate survey of this immense territory. In fact, it is no longer a single subject, but has become a group of numerous more or less distinct but chemically related subjects. The author of a one-volume text-book in this important branch of scientific human knowledge, therefore, has presented to him the alternative of restricting either the number

of the topics and classes of compounds presented, or the discussion of those which are included.

In the book under review, the authors have been guided by their evident desire to follow the former of the above alternatives and reduce the list of topics rather than the thoroughness of their treatment. This has been achieved mainly by totally ignoring one of the three major divisions of the subject, namely, that of the heterocyclic compounds. A more accurate title for the volume, therefore, would be "Aliphatic (Acyclic) and Carbocyclic Organic Chemistry."

Another sacrifice in the interest of brevity has been the omission in the text of citations to the original literature. In their place, a select list of reading references is given at the close of each chapter. Space has also been economized by the insertion of numerous tables of compounds and of their physical and chemical properties. Apparently one object of this rather severe limitation of the topics, classes and compounds to be considered has been to provide space for what the authors regard as the most novel feature of their book—that is, the inclusion, for optional reading, of a certain number of chapters pointing out the importance of organic chemistry in technology, industry, biology and medicine. Such general reading would probably comprise the chapters on Rubber, Microbiological Processes, Role of Carbohydrates in Biological Processes, Metabolism of Fats, Metabolism of Proteins and Amino Acids, Synthetic Fibers, Synthetic Plastics and Resins, Accessory Dietary Factors and Advances in Chemotherapy.

The underlying plan of the work has been first to make clear to the reader the elements of the subject by a discussion of the chemistry of such relatively simple groups as the aliphatic hydrocarbons, alcohols and acids, and then to lead him forward gradually through more intricate and difficult fields; simultaneously replacing the older empirical theoretical explanations by more modern and more scientific ones.

All organic chemists are familiar with the splendid contributions which Dr. and Mrs. Fieser have been making for many years in the lecture room and laboratory, and as authors. No one is better qualified to prepare an exceptionally fine general treatise in this branch of science, and the result of their labor is a book which, in thoroughness and clarity of presentation, authoritative and up-to-date information, and the fascination of the world it discloses, is unexcelled. It should be in the possession of every one interested in organic chemistry. It is to be hoped that the authors will find time later for a companion volume devoted to the heterocycles.

Marston Taylor Bogert
Columbia University

SPECIAL ARTICLES

THE URINARY EXCRETION OF PENICILLIN AFTER ORAL ADMINISTRATION TO NORMAL HUMAN SUBJECTS[1]

Early studies on the absorption and excretion of penicillin[2] suggested that oral administration was not effective in attaining adequate blood levels that were required for the treatment of severe infections. The destruction of penicillin by the acid gastric contents appeared as a possibility to account for the results obtained.[2,3] Until quite recently only very limited amounts of penicillin have been available and it has been highly desirable to use it in the most efficient manner possible. However, it would appear that the supplies of penicillin will be enormously increased[4] so that it becomes possible to consider less efficient but more convenient means of administering the drug. Certainly oral administration is the method of choice in the majority of instances from the standpoint of both the patient and the attending physician. For this reason it seemed desirable to re-examine the urinary excretion of penicillin after the oral ingestion of relatively large doses in order to ascertain if therapeutically effective quantities might be absorbed from the gastrointestinal tract. The present report describes studies of the urinary excretion of penicillin following its oral ingestion, either alone or along with sodium bicarbonate by normal human subjects.

A solution of the sodium salt of penicillin containing 500 Oxford units per milligram of total solids was employed in these studies. In all cases the subjects were fasting for 3 to 6 hours but not longer than this. All assays were carried out by the cylinder plate technique on suitably diluted urine specimens.[5] Table 1 shows the amount of penicillin excreted in the urine by two males (A and C) and one female (B) following the oral ingestion of 100,000 Oxford units. Two studies were made on subject A. It will be seen that from 8 to 33 per cent. of the quantity taken by mouth was excreted in the urine. The average rate of urinary

[1] From the Ben Venue Laboratories Inc., Bedford, Ohio, and the Department of Biochemistry, School of Medicine, Western Reserve University, Cleveland, Ohio. This article was received on June 3, 1944. It has now been released for publication.

[2] C. H. Rammelkamp and C. S. Keefer, *Jour. Clin. Invest.*, 22: 425, 1943.

[3] C. H. Rammelkamp and J. D. Helm, Jr., *Proc. Soc. Exp. Biol. and Med.*, 54: 324, 1943.

[4] R. D. Coghill, *Chemical and Engineering News*, 22: 588, 1944.

[5] W. H. Schmidt and A. J. Moyer, *Jour. Bact.*, 47: 199, 1944.

TABLE 1

URINARY EXCRETION OF PENICILLIN FOLLOWING THE ORAL INGESTION OF PENICILLIN

Subject	Total excretion following ingestion of 100,000 Oxford units	Total excretion following ingestion of 100,000 Oxford units and 10 gm Na HCO_3
A	22,200	12,700
A	33,600	
B	8,800	1,950
C	16,300	4,300

excretion for the three subjects is indicated by Fig. 1. The maximum excretion occurred during the first hour and all penicillin had essentially disappeared from the urine by the end of 6 hours. No untoward reactions were noted in any of the three subjects.

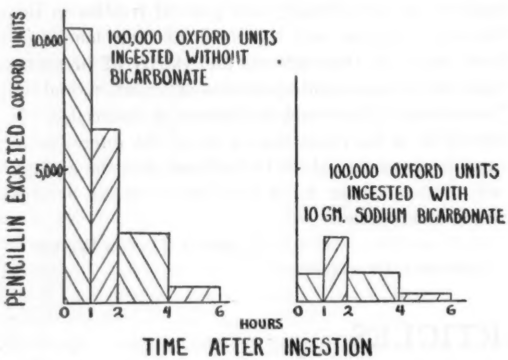

FIG. 1. The rate of urinary excretion of penicillin following its oral ingestion by human subjects.

It has been suggested[3] that the simultaneous administration of sodium bicarbonate might decrease the amount of destruction of penicillin in the gastrointestinal tract. Results of studies in which 100,000 Oxford units of penicillin were ingested along with 10 grams of sodium bicarbonate are also shown in Table 1. It will be seen that in each of the three subjects the amount of penicillin excreted was quite definitely decreased. In subject A the amount of penicillin excreted was approximately half of that noted when the penicillin was ingested alone, whereas the excretion of penicillin by subjects B and C was only 20 to 25 per cent. as great when the bicarbonate was taken along with the penicillin. The reason for the decrease in penicillin excretion is not readily apparent. In the first place the bicarbonate may sufficiently decrease gastric emptying so that there is more destruction of the substance in the stomach. This is consistent with the results indicated in Fig. 1 which show that the maximum penicillin excretion occurred in the first hour when the penicillin was ingested alone, but when sodium bicarbonate was also ingested the maximum penicillin excretion was delayed and occurred between 1 and 2 hours. A second possibility is that the alkaline urine which is excreted following bicarbonate ingestion causes a destruction of the compound while the urine is in the bladder.

Comparison of the quantity of penicillin excreted after oral ingestion with that after intravenous administration suggests that some of the compound is destroyed in the intestinal tract. However, it would appear from the above data that if the doses of penicillin administered orally are larger than those that are effective by intravenous administration, then one might reasonably expect that an adequate amount of the drug will be absorbed and will provide a therapeutic effect in the treatment of infections by susceptible organisms. For instance, the amount of penicillin excreted by each of the subjects after oral ingestion was of the same order of magnitude or larger than the quantity used in many single clinical intravenous or intramuscular injections. A possible added advantage of oral administration is that the absorption continues over some period of time so that the effects of an elevated blood level of penicillin will be prolonged.[6]

ALFRED H. FREE
JACK R. LEONARDS
D. ROY MCCULLAGH
BARBARA E. BIRO

PROLONGING EFFECTIVE PENICILLIN ACTION[1]

"PROLONG penicillin" has now become a slogan for clinical research workers seeking to extend the effective action of this wonder-working but evanescent drug. When administered in saline solution by intramuscular injection, over half of the penicillin is soon excreted in the urine, requiring renewed dosages every two or three hours. Effective levels have recently been prolonged by using a penicillin beeswax-peanut oil mixture.[2] The authors of this report have tried a new approach to the problem involving the well-known principle of chilling, in order to slow down the circulation in and around the site of the intramuscular injection.

MATERIALS AND METHODS

This simple method was first tried, beginning Sep-

[6] Since completion of the above study 10 additional studies have been made of the excretion of penicillin following the oral ingestion of 100,000 Oxford units. The excretion pattern and total excretion of penicillin corresponded with the results described above.

[1] The opinions and views set forth in this article are those of the writers and are not to be considered as reflecting the policies of the Navy Department.

[2] "A Method of Prolonging the Action of Penicillin," by M. J. Romansky and G. E. Rittman. SCIENCE, vol. 100, No. 2592, p. 196, Sept. 1, 1944.

tember 13, 1944, on a series of ten patients, nine with a diagnosis of gonorrhea and one with an acute urethritis and extra-cellular diplococci. The penicillin was administered intramuscularly in saline solution, with one therapeutic injection on each subject.

An ice bag was applied on the arm of Subject No. 1, at the deltoid muscle for one hour prior to and for five hours after the injection of 50,000 units of penicillin. The result was that an effective blood level was maintained for 5 hours as compared to 2½ hours usually maintained by a similar dose of penicillin in saline without the advantage of cold applications. The patient's smears became negative for G.C., within six hours and he remained bacteriologically negative and free from symptoms for the remaining two weeks in the hospital.

Subject No. 2 was iced for two hours prior to the injection of 50,000 units and the chilling technique was continued for a period of 6 hours.

Subjects Nos. 3 and 4 each received a single dose of 100,000 units and the area around the intramuscular injection was iced 2 hours before and 6 hours afterwards. The blood penicillin levels at the end of 6 hours were bacteriostatic. In these first four cases blood specimens were obtained for only six hours following the intramuscular injection.

In the remaining six subjects the upper arm was iced 2 hours before and 12 hours after a single intramuscular injection of 50,000 units except that subject No. 10 received an injection of only 30,000 units. In order to obtain the maximum chilling from the ice bag, the bags of melted ice were replaced every few hours with bags of ice. In addition the ice bag was supported or encased in a harness (see Fig. 1) and attached by elastic bands to the upper arm and an elastic anchor around the neck. Effective bacteriostatic levels were maintained for a period of 12 hours in five out of six cases.

Harness secured to arm & neck by elastic bands.

FIG. 1

RESULTS

All patients, except Subject 10, conform to a general pattern of effective and prolonged blood penicillin levels, following a single intramuscular injection. All patients except No. 10 became bacteriologically and clinically negative and remained so during their stay of from one week to two weeks at the hospital. In the case of No. 10, the urethral discharge stopped the evening of the day he received 30,000 units of penicillin, but at noon the next day the discharge recurred and laboratory reports were again positive. This was the only exception in obtaining protracted bacteriostatic levels.

COMMENT

Before the chilling technique was introduced, a Naval Hospital which had administered intramuscularly a total of 100,000 units of penicillin in two doses, 6 hours apart, to each of 20 gonorrhea patients, failed in 45 per cent. to effect a cure. Ten additional patients with gonorrhea had been given a single intramuscular injection of 50,000 units. Of these cases 80 per cent. were not cured. Therefore it is significant that with the use of the chilling technique, there were no failures in all the cases* which received a single intramuscular injection of 50,000 units.

Additional patients are being given this dosage with the chilling technique. When further studies confirm these findings it may be concluded that continuous chilling applied at and around the site of the intramuscular injection will have the following advantages.

(1) Bacteriostatic levels of penicillin can be maintained by 2 or 3, instead of from 8 to 12 intramuscular injections in 24 hours.

(2) The application of an ice bag two hours in advance of the injection also renders the injection painless.

(3) There is a 50 per cent. saving in the total amount of penicillin required for each patient.

SUMMARY

(1) Single injections of penicillin in saline administered intramuscularly with ice applications at the site of the injection produced and maintained bacteriostatic levels for six to twelve hours in nine out of ten patients, nine of whom were diagnosed as

* The chilling technique has since been applied consecutively to eight additional gonorrhea patients. All were cured bacteriologically and clinically by a single intramuscular injection of 50,000 units of penicillin in saline solution.

having gonorrhea and one urethritis with extracellular diplococci.

(2) There was one failure, Subject No. 10, who received only 30,000 units.

(3) Eight of the patients with gonorrhea and the one patient with urethritis were cured (bacteriologically and clinically) by this single intramuscular injection of penicillin.[3]

MAX TRUMPER,
Lieutenant Commander, H-V(S), U.S.N.R.
NAVAL MEDICAL RESEARCH INSTITUTE,
NATIONAL NAVAL MEDICAL CENTER
A. M. HUTTER,
Lieutenant Commander (M.C.), U.S.N.R.
NATIONAL NAVAL MEDICAL CENTER,
BETHESDA, MD.

STUDIES ON THE RELATION OF PNEUMOTROPIC STREPTOCOCCI TO INFLUENZA VIRUS[1]

SEROLOGICALLY distinct pneumotropic streptococci, which were used in these experiments, were isolated in studies of influenza and other respiratory infections in our brain-containing mediums, dextrose-brain broth and soft dextrose-brain agar (0.2 per cent. dextrose and 0.2 per cent. agar). These mediums are highly favorable for the isolation of specific types of streptococci and for obtaining pure cultures without loss of specificity.

White mice were inoculated intranasally with these streptococci, which had been subjected to one or more serial dilution cultures alternately in dextrose-brain broth and dextrose-brain agar.[2] The streptococci that grew at the end point of growth were used. All streptococci inoculated were so far removed from the original source that the possibility of passive transfer of "natural" influenza virus was eliminated. By serial intranasal passage, through mice and embryonated chicken eggs, of emulsions and filtrates of emulsions of pneumonic lungs thus obtained, and of allantoic fluid of infected embryonated eggs, a pneumotropic, filtrable infectious agent, transmissible in series, was obtained. The filtrable infectious agent was obtained from each of twenty-nine cultures of pneumotropic streptococci: fourteen cultures from the nasopharynges or blood of thirteen persons having acute epidemic influenza, eight cultures of streptococci from a milk supply and two from a strain isolated from freshly fallen snow during epidemics of influenza and five strains isolated by me from "natural" influenza virus which had been sent to me for study.

Under conditions employed successfully by others, influenza virus was obtained, by intranasal inoculation of mice, from filtrates of nasopharyngeal washings of six out of thirty patients during the acute stage of influenza.

Each of the strains of the filtrable infectious agent obtained from twenty-nine cultures of pneumotropic streptococci has been passed successively through from six to eighteen serial passages. Lesions of lungs occurred in altogether 1,130 (57 per cent.) of 1,900 mice inoculated with test material.

After a number of serial intranasal passages of the filtrable infectious agent obtained from pneumotropic streptococci, the incidence, type and degree of gross and microscopic lesions that developed in the lungs of mice were essentially the same as the incidence, type and degree of those that developed after intranasal inoculation of "natural" influenza virus. The incidence of isolation of streptococci from pneumonic lungs of mice that had received the experimental infectious agent and those that had received "natural" influenza virus also was similar. Isolations of streptococci and incidence of lesions, especially in the first number of serial passages, often ran parallel but, in general, isolations of streptococci diminished progressively with serial passages.

Strains of streptococci isolated from pneumonic lungs in the two groups of mice, those receiving the experimental infectious agent and those receiving "natural" influenza virus, had moderate pneumotropic virulence. Five strains of streptococci from the latter group, far removed from virus, yielded the infectious agent on successive passage of lung material, beginning with the streptococcus. The streptococci from both groups were agglutinated specifically by the influenza antistreptococcic serum and by convalescent influenza serum.

The infectious agent produced from streptococci was as filtrable as "natural" influenza virus and remained viable on preservation in 50 per cent. glycerin for as long as three months.

The invasive power of both the experimental infectious agent and virus and of the influenzal type of streptococcus was neutralized by the influenza antistreptococcic serum and by convalescent influenza serum but not by normal horse serum or normal human serum.

Mice that were immunized intranasally or intraperitoneally with vaccines prepared from freshly isolated streptococci that had been isolated from nasopharynges or blood of persons having symptoms of

[3] The cooperation of Commander G. J. Thompson (M.C.), U.S.N.R., chief of the Urological Service, and Lieutenant P. V. Wooley, Jr., officer in charge of the Bacteriological Laboratory, is appreciated. The blood assays were made by Barbara C. Unsworth, PhM1c, and W. E. Lenert, PhM3c, using a serial dilution method. The sketch of the ice-bag harness was made by J. Di-Ferdinando, PhM3c, S-V, U.S.N.R.

[1] Preliminary report.

[2] E. C. Rosenow, *Arch. Path.*, 26: 70, 1938.

acute influenza became resistant to intranasal inoculation of the experimental infectious agent and "natural" influenza virus. Hence, the use of both streptococcic and viral vaccines in prophylaxis should afford protection.

The possibility that the infectious agent obtained in these experiments might represent pickups of latent or spontaneous pneumotropic virus, described by others,[3-7] in mouse stocks was considered and a report has been withheld until the evidence against such possibility seemed conclusive. Since the different strains of the infectious agent obtained by me from pneumotropic streptococci and "natural" influenza virus isolated by others are alike, the possibility of pickups of the latent virus in mice applies equally to my experiments and to the isolation and propagation in mice of "natural" influenza virus by others. The controls in both instances suffice, it would seem, to eliminate this possibility. Control inoculations made in 712 mice during the course of these experiments with (1) emulsions or filtrates of emulsions of lungs of normal mice and of the few uninoculated mice in which lesions of lungs had been found, which, however, clearly were different from those in test mice; (2) filtrates of dextrose-brain broth cultures of the streptococcus, and (3) filtrates of dextrose-brain broth and chick-embryo medium, and inoculations made in 1,142 mice with non-pneumotropic streptococci from sources remote from influenza, did not yield the infectious agent.

The data obtained indicate that the pneumotropic, filtrable, transmissible infectious agent obtained from pneumotropic streptococci appears to be true influenza virus, as now understood, and that pneumotropic streptococci in influenza and related respiratory infections, such as primary atypical pneumonia and influenzal bronchopneumonia, may be an important source of what is now considered virus.

EDWARD C. ROSENOW,
Now Professor Emeritus
DIVISION OF EXPERIMENTAL BACTERIOLOGY,
MAYO FOUNDATION,
ROCHESTER, MINN.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

SCREW-CAPPED BACTERIOLOGICAL CULTURE TUBES

A NEW screw-capped bacteriological test-tube has been placed on the market by the Will Corporation.[1] This test-tube has been tried in our laboratory and has been found to have certain advantages over the conventional cotton-plugged culture tube. For example, media that need to be made up only occasionally can be kept in the screw-capped tubes fresh and moist at room temperature for many months. The experience with this new tube has shown, however, that it still could be improved considerably by extending the length of the screw cap and the neck of the tube from the present length of about 10 mm to the least 25 mm without changing the thread.

Fig. 1 shows the suggested shape and length of the neck with the screw thread and the cap. Three important improvements could be achieved by such modification of design. (1) Tubes with long caps and necks can be incubated with the caps slightly unscrewed to permit the same free exchange of air as through the usual cotton plugs, without any increased danger of contamination, whereas with the short caps contamination occurs readily if the caps are not closed tightly. (2) Since the present short caps must be closed tightly immediately after the removal of the test-tubes from the sterilizer, because otherwise they do not protect the medium sufficiently from contamination during the process of cooling, a negative pressure develops in the cooled-off tubes. When such

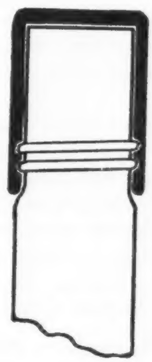

FIG. 1

partly evacuated tubes are opened for inoculation, the air current entering the tubes may sometimes introduce contaminating microorganisms. Also, the short cap will stay in place only when screwed on so far that the vinylite lining of the cap sticks to the end of the tube, whereupon inrushing air forces the lining suddenly down into the tube. By having the necks and the screw caps much longer than the present ones,

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[4] F. B. Gordon, Gustave Freeman and J. Marion Clampit, *Proc. Soc. Exp. Biol. and Med.*, 39: 450, 1938.
[5] F. B. Gordon and Helen V. Karr, *Proc. Inst. Med. Chicago*, 14: 370, 1943.
[6] Helen V. Karr, *Jour. Infect. Dis.*, 72: 108, 1943.
[7] Clara Nigg, SCIENCE, n.s., 95: 49, 1942.
[1] Catalog Supplement Number Three, p. 21, No. 16535.

the test-tubes could be cooled off slowly with the caps entirely unscrewed but still fitting tightly enough over the long necks of the test-tube to prevent the contamination, thereby permitting the equalization of air pressure on the inside and the outside of the test-tubes without contamination. (3) Longer caps can be held more securely between the fingers when the cultures are being transferred.

The test-tubes with properly constructed screw caps can prove to be more versatile, and in certain types of bacteriological work can be superior, to conventional cotton-plugged tubes.

S. F. SNIESZKO

MAINE AGRICULTURAL EXPERIMENT STATION,
ORONO, MAINE

PREPARATION AND STORAGE OF AUTOPSY NERVE GRAFTS

THE use of prepared nerve grafts in bridging nonsuturable peripheral nerve gaps is a recognized neurosurgical procedure of great value.[1–5] As a consequence, means have been devised of preparing and storing graft material which facilitate its use at operation. Applicable primarily to experimental work are those measures utilizing direct aseptic transfer.[6–8] In addition efforts at relatively permanent storage utilizing freezing-drying, dehydration and cold storage have been introduced by Weiss and Taylor.[9] The disadvantages in elaborate preparation and storage are at once apparent. The following procedure is offered as a simple flexible method of preparing and storing autopsy nerve grafts which is adaptable to any size or complex of nerves, and simplifies pre-operative sterilization through the expedient of alcohol immersion of the containing vial similar to sterilization of suture material.

The nerve or nerve complex is dissected as cleanly as possible at autopsy and placed in tap water. Using clean instruments the material is freed of all excess fibrous tissue. The stripping of straight nerves such as antibrachial cutaneous, ulnar, median, musculocutaneous, radial, femoral, obturator and sciatic imposes no difficulty. Cleaning of more elaborate complexes such as the brachial plexus requires repeated moistening and dissection of the unwanted tissue. The material is next sized. For most purposes lengths of 7 centimeters suffice. For nerves of smaller diameter this length is rarely required. Appropriate lengths are cut and the pieces of larger girth (median, radial etc.) tied under moderate tension to segments of glass tubing with the string passed through the cylinder of glass. The smaller pieces (antibrachial cutaneous, obturator, etc.) are fixed to ordinary mimeograph paper strips by inserting the ends under slit loops.

Fixation is accomplished by immersion in 10 per cent. formalin for three days. The material is then subjected to running tap water wash over night and dehydrated to 70 per cent. ethyl alcohol. Three changes of ethyl alcohol are employed over a period of 3 days to assist in sterilization. The tissue is then hydrated aseptically by repeated washes of distilled water, then placed in sterile saline overnight. The nerves are then transferred to saline in sterile vials of soft glass and sealed. Sterility is checked by aerobic and anaerobic cultures of the first saline wash.

The larger nerves retain their position in fixation and are freed from the supporting glass for introduction into the vials. The paper mounts of the smaller nerves may be rolled and introduced into the vial with the nerves attached to prevent distortion of the smaller structures freed of their support. Bulky preparations (brachial plexus) do not lend themselves to the storage technique described above. On the few occasions these have been required the material has been spread out and sutured to thick white cardboard and passed through the formalin into 70 per cent. ethyl alcohol in which they have been stored until just prior to operation.

Material prepared as described above has been retained at room temperature for periods up to 5 months with no sign of deterioration. Experiments employing these grafts have given excellent results and the procedure is now standard in the division of neurosurgery.

GENO SACCOMANNO
JOHN VAN BRUGGEN
JEFF MINCKLER
ROLAND KLEMME

ST. LOUIS UNIVERSITY,
SCHOOL OF MEDICINE

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SCIENCE NEWS

Science Service, Washington, D. C.

THE NOBEL PRIZES

The two winners of the 1943 Nobel prize in medicine tell in their own words what their researches on the anti-bleeding vitamin K mean to the world and what new developments may be expected. Modern physics aided the two 1944 Nobelists, one of them states, describing their joint work:

Gladly surprised at being recipient of a Nobel prize in medicine, my thoughts turn to work still to be done on vitamin K as well as to the days of its discovery.

Future research must clear up the manner in which vitamin K acts to promote the formation of prothrombin, one of the blood chemicals essential for normal clotting of blood when shed. It is only known that the process takes place in the liver.

It also remains to be found out what role vitamin K plays in the green plants and in bacteria.

Vitamin K, first found in Copenhagen in experiments with chicks, is necessary for blood clotting. Without vitamin K fatal bleeding occurs even from minor wounds.

Vitamin K is fat-soluble and occurs in various foods, especially in green vegetables. It also occurs in putrefaction bacteria.

Vitamin K prevents bleeding diseases which are due to lack of prothrombin, a protein-like substance occurring in the blood of normal persons. Vitamin K is not related to the hereditary bleeder's disease, hemophilia. Vitamin K deficiency occurs in cases of so-called obstructive jaundice caused by gall stones or tumors which obstruct the flow of bile into the intestine, bile being necessary for the absorption of vitamin K from foodstuffs through the intestinal wall into the blood stream.

Death from continuous bleeding was formerly a very serious problem in surgical operations on such patients, but this risk is now avoided by suitable administration of vitamin K.

Newborn babies are usually more or less vitamin K deficient because the vitamin does not readily pass over from mother to fetus. Danger of bleeding exists in many newborn in the first few days after birth. This danger is prevented and the death rate among the newborn reduced by administration of vitamin K to the baby immediately after birth. Certain forms of sulfa drug treatment will kill the bacteria in the patient's intestine, thereby excluding an important source of vitamin K. Vitamin K therapy is advisable in such cases.

Uncontrolled excessive use of mineral oil may interfere with the proper absorption of vitamin K as well as of other vitamins.—Henrik Dam.

During the decade following Dr. Dam's discovery of vitamin K, the combined efforts of several groups of investigators have solved many of the important problems connected with vitamin K. Sources of the vitamin were discovered and in my laboratory methods of extraction and purification were devised. A satisfactory bioassay method was developed, and the isolation of vitamin K1 (from alfalfa) and K2 (from putrefied fish meal) was effected. The structures of K1 and K2 were elucidated and the structure of K1 verified by synthesis and of K2 by degradation studies. In addition, simple water-soluble compounds with antihemorrhagic properties were prepared for clinical use.

Many investigators had previously attempted to ascertain the cause of the impaired coagulation of blood in obstructive jaundice but it was not until 1935 that Dr. A. J. Quick and his associates devised a satisfactory method for the determination of prothrombin and showed that in obstructive jaundice the prothrombin concentration may be markedly reduced. The delayed coagulation in obstructive jaundice as well as in vitamin K deficient chicks can be corrected by the administration of vitamin K and bile or of the simple-water-soluble compounds with antihemorrhagic properties. In certain diarrheal diseases, such as ulcerative colitis, sprue and celiac disease which may cause hypoprothrombinemia, the intravenous therapy of vitamin K is effective. Another important therapeutic use of vitamin K is to correct the hemorrhagic disease of the newborn. The treatment is extensively and effectively used in the mother prenatally or in the infant after birth.—Edward Doisy.

The work for which the 1944 Nobel prize in medicine was awarded to Dr. Joseph Erlanger, of Washington University, St. Louis, and myself, is the direct outgrowth of the advancements of modern physics.

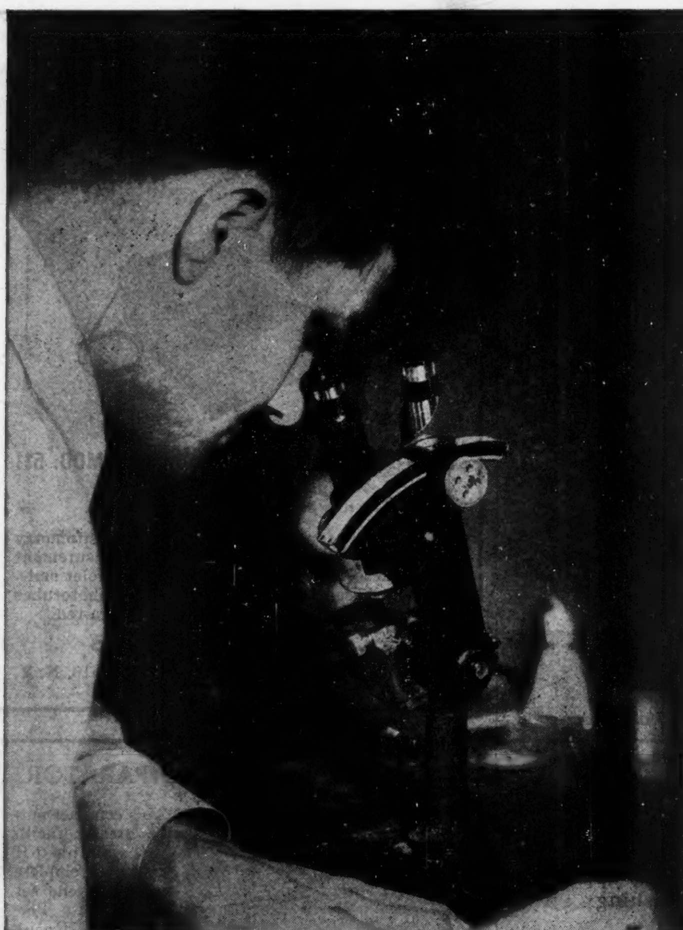
One of the signs of activity in the nervous system is a change in the electrical potential accompanying the events and this sign is the only one that tells when the events take place. These changes are so small that formerly they were difficult to detect and at the same time the inertia of the recording instruments distorted their time course. After the advent of the vacuum tube amplifier and the cathode ray oscillograph it was possible to develop a technique that surmounted both difficulties and then many older observations could be clarified and new ones brought to light.

The first developments were in relation to the peripheral nerve. It was possible to reveal differences in the individual fibers that make up a nerve, differences in the velocity with which impulses are carried related to the size of the axons and differences related to the kind of fiber, for it has turned out that fibers can be divided on criteria other than velocity into three classes.

To a limited extent the several groups of fibers could be related to the physiological significance of the messages they carry. The events in the course of a single impulse in the fiber were determined with accuracy as to time and correlated with states of the nerve.

Certain events correlate with the momentary excitability of the fiber and this correlation forms a useful link in the chain leading up to an analytical study of the central nervous system. Some of the simplest neuron chains in the latter have been examined. But the subject is still in its infancy.

There are alluring prospects ahead with respect to the unravelling of how the central nervous system works. Needless to say, the foregoing summary contains allusions to contributions for which neurophysiology is indebted to the work of others than ourselves.—Herbert S. Gasser.



Spencer Refractometer in use in the Research Laboratory of the Pennsylvania Grade Crude Oil Association.